time does not now allow of my repeating it. Suffice it to say that the present operation of these valuable prizes is directly antagonistic to their supposed objects. Instead of promoting science and learning they serve only to make the university an arena in which young men contend for money prizes, and those who should be teachers are engrossed in training, handicapping, and settling the conditions of the race. The operation of emulation, honours, and prizes as a stimulus in school education is somewhat doubtful. But in the highest stage of liberal education it is necessary, if science and letters are to work with their cultivating effect on the mind, that they should be disengaged from all mercenary attractions. But when prizes of such magnitude as Fellowships are employed to attract students they become themselves the all-engrossing objects of pursuit. In Oxford and Cambridge, taken together, an amount of not less than 150,000*l.* a-year is spent on prizes. The sum is in itself an insignificant fraction of the national income, but it far exceeds the whole outlay which the country makes on science and learning. The bestowal of these lavish prizes corrupts instruction at its sources. No reform, having for its object to make the universities the home of science and learning, can be effectual which does not begin by suppressing this wholesale pensioning of youthful sinecurists. I have reminded you of one old academical saying; there is another which recurs now to my recollection, 'A Fellowship is the grave of learning.' I have spoken only of our old Universities, or rather of Oxford, because I know it best. But I must not forget that there are younger institutions which are struggling upwards towards the ideal of a university, as I have described it in Prof. Huxley's words, 'a corporation which has charge of the interests of knowledge as such.' At the head of these I must place Owens College, not only because it is in Lancashire, but because in its staff of Professors it possesses a body of men who are truly representative of knowledge in a variety of its most important departments. In a single generation we have seen this College rise from humble beginnings to a position in which it can put forward a claim to be incorporated as a university, with the privilege of giving degrees. Its capitalised sources are, indeed, small. In addition to the original 100,000*l.* of Owens' bequest, about 220,000*l.* has been contributed by voluntary subscribers, an insignificant sum when compared with the wealth of the great manufacturing metropolis. These funds, too, have been raised almost exclusively in a very small circle and by a very few public-spirited individuals; they have not been drawn from the general mass of manufacturing wealth in Manchester or the neighbouring district. With material means so inadequate, the scientific eminence attained by this young institution is a remarkable example of intellectual vigour, which must dispose us to regard favourably its claims to incorporation. But there is, besides, an immediate practical requirement which compels Owens College to seek without delay the right of conferring degrees. It is this: that as long as its students are under the necessity of graduating through the University of London, they must pass through the examinations required for the London degree. Consequently the professors of Owens College can never take the free and independent position of teachers of science. It is inevitable that they must prepare their pupils for examination, and every true teacher knows too well that this process is incompatible with genuine instruction in letters and science. The efficiency of a local university is not to be measured by the amount of its annual income, nor its success by the number of its pupils. Does it profess to teach and represent human knowledge in all its main branches and in its most complete forms? Is each great department occupied by men who are in possession of the long tradition of the past and zealous in searching out what still remains unexplored? Is liberal culture recognised as its basis, and progressive science as its aim? Where these conditions are fulfilled it would be hard to say why such an institution should not be entrusted by the State with the privilege of marking its students with the public stamp of certified acquirement. If it were merely a question of comparative qualification it would be difficult to maintain that Durham possesses, and that Owens College does not possess, the capacities, extensive and intensive, which I have supposed to be required. But if in the next twenty years the growth of Owens College is in proportion to its advance in the last twenty, the question will by that time have settled itself."

No words of ours could add to the force of this address, coming as it does from one in the position of its author. When we contrast the actual state of things in our English Universities with the ideal which appears in the above address and in that of Prof. Huxley at Baltimore—an ideal which has almost become a reality in America—any well-wisher of his country and of learning cannot but feel regret at the opportunities that have been lost, and the almost hopelessness of any rapid improvement.

THE FIFTH MEETING OF RUSSIAN NATURALISTS

THE fifth meeting of Russian Naturalists was opened September 12 at Warsaw. The Russian Naturalists are not yet organised into a permanent association, although it is their wish, repeatedly expressed, to found an association on the same principles as the British. A special imperial permission must still be obtained before each meeting, the rules of the meeting being settled by imperial decree, and a sum of money allowed for expenses and publications. The sittings of the sections are open only to members and persons introduced by them, membership being allowed only to those who have made direct contributions to science, as ordained by the rules. The meetings of the united sections for the transaction of general business and for lectures of general interest, are held in public, usually in presence of a numerous audience. The meeting (for it can hardly be called an association) publishes a daily bulletin of transactions, and issues, in the course of the year, one or two large volumes of memoirs (*Troody*) containing lectures, and longer papers *in extenso*, together with such contributions as separate societies of naturalists have found too expensive to publish in their journals.

The Warsaw meeting was largely attended by naturalists from all parts of Russia, but especially from St. Petersburg, Moscow having but few representatives. The number of members was about three hundred, the sections of Scientific Medicine and Chemistry being especially full. There were very few foreign naturalists, the organising committee not being allowed by the rules to send invitations abroad. Prof. Brodofsky, president of the Committee, was elected president of the meeting, and the St. Petersburg professors, Mendeléeff and Butleroff, vice-presidents. The ten sections of the meeting transacted a great deal of business during the nine days the Naturalists were assembled, and we may give afterwards some account of the papers read, referring now only to lectures delivered at public meetings.

At the first meeting Prof. Dobrzycki read an interesting medical paper, "On the Principles of Research into the Causes of Diseases." Several propositions as to the permanent organisation of future meetings, the opening of a Society of Naturalists at the Warsaw University on the principles adopted for the societies already existing in connection with all universities in Russia, the holding of an international meeting of naturalists, and the publication of an international daily scientific paper, were read and referred for discussion to the sections.

The second public meeting was especially crowded with the public. Two papers were read by Prof. Goyer and Prof. Halubinsky. The former, "On the Importance of Practical Scientific Institutions" (laboratories, physical cabinets, zoological stations, &c.), insisted on the necessity of such institutions for the successful teaching of natural science, and pointed out how little time is generally allowed in universities for the practical study of science, the greater part of the students' time being occupied by the lectures of the professors. M. Goyer forcibly illustrated the influence exercised by practical studies on the student, not only by affording him the only possible means of acquiring a profound knowledge of science, but especially by developing the independence of his judgment, the critical powers of his mind, and his inventive faculties.

The lecture of Prof. Halubinsky, "On the Genetic Method in the Teaching of Natural Science," treated a closely allied subject. The professor pointed out the deplorable state to which the teaching of natural science was lately reduced in Russian colleges, and insisted that only a thorough study of the natural sciences can adequately develop the analytical faculties of the mind, and that such development cannot be sufficiently attained by the study of languages and mathematics. He insisted further on the urgent necessity of fundamental changes in the arrangement of most of our handbooks of natural sciences, these handbooks beginning mostly with generalisations, instead of simply helping the scholar to arrive at them himself by means of comparison and of the analysis of the properties of objects and phenomena. The lecture provoked a lively discussion, some opposition being manifested by college teachers.

Prof. Famintzin presented Collections (*Sborniki*) made from separate copies of all papers published since the last meeting in the *Memoirs* of the six Societies of Naturalists annexed of the universities. The societies having agreed to print their journals in one uniform size, 100 separate copies of each paper published are sent to the St. Petersburg Society which makes up from them *Recueils* arranged under the heads of Geology, Botany, and Zoology. Thus those who are interested in only one of these branches can dispense with purchasing whole periodicals, the *Recueils* being sold at the St. Petersburg Society at a very low price. Here is a fine example for imitation by our various English provincial societies.

The proposal to request from the Minister of Public Instruction permission to found a Society of Naturalists at Warsaw, was met most favourably, as well as the proposal of Prof. Wagner to establish on the Solovetzky Islands a Zoological Station on the same principles as that at Sebastopol; as also was the proposal of M. Grimm to request the help of the Naval Department for dredgings in the Black Sea. MM. Grimm and Bogdanoff informed the meeting that they had undertaken two publications, a popular periodical, "Herald of Natural Science," for which they begged the co-operation of the naturalists, and a periodical in French or German, which would give to foreign readers brief notices of scientific work in Russia. This last idea was warmly supported by Prof. Mendeléeff, who proposed to request the government for pecuniary help for the publication; but this proposal having met with some opposition, it was returned for discussion in the sections.

A few excursions were made by the members, and a visit was paid, among others, to the Warsaw Institute for Deaf-Mutes and the Blind. The director of the Institute, Prof. Poplavsky, delivered on this occasion an interesting lecture on the causes of deaf-muteness, tracing them not only to the bad constitution of parents, but also to marriages between near relations. He energetically combated the opinion of Mr. George Darwin, who has endeavoured to prove by statistical evidence the fallacy of the generally accepted opinion as to the importance of the latter cause, and said that Mr. Darwin would probably change his opinions, had he the opportunity of examining the registers kept at the Warsaw Institute and elsewhere, as to the parentage of the deaf-and-dumb. The visitors had also an opportunity of witnessing the remarkable educational results arrived at by the Warsaw School. Mimic language being almost totally prohibited, the pupils are taught to understand the motion of the lips and to speak more or less distinctly; and after a four years' residence in the Institute they generally attain in both a high degree of perfection. The best result of the school is, that pupils who finish their education (technical) in the Institute immediately find employment in trades, the situations offered to them generally exceeding the number of candidates.

The usual dinner of naturalists was most animated, a very rare occasion now-a-days, as the correspondent of the *Golos* says, when Poles and Russians meet together in Warsaw. The want of friendship which was observable during the first days of the meeting, gradually disappeared, and all united most heartily in support of the toasts for the international influence of science, for the prosperity of natural science in schools, &c. Of course, a public meeting being now impossible in Russia without manifestations in favour of the struggle for independence of the southern Slaves, the usual collections were made, and a telegram was sent to General Tchernaieff with wishes for victory.

At the closing public meeting Dr. Rothe read a paper "On the Insane, and on Asylums for them." Treating the subject at great length, he concluded by animadverting on the insufficient number of asylums existing now in Russia, and proved by figures that the insane, when submitted to early medical treatment, recover in far larger numbers than is generally supposed; 70 per cent. if the treatment begins during the first months after the appearance of the disease, while those who enter the asylums with the disease about two years old, have hardly any chance of recovery. After the delivery of the lecture, various conclusions and propositions of the sections were discussed. St. Petersburg and Odessa being recommended as the place for the next meeting, a ballot decided in favour of the capital, the time of meeting to be announced during the coming winter. Resolutions were carried to request the Societies of Naturalists annexed to universities (which were organised by the initiative of the first meeting), to present in 1877 reports of their ten years activity; to change the name of the gathering into "Meeting of Naturalists and Physicians;" to raise a fund for a permanent student's scholarship in honour of Prof. Kessler, to whose initiative and many years' labours the first meeting was due. The proposal of Prof. Dobrzycki as to an inquiry into the causes of diseases, was negatived as involving too many practical difficulties, as were also the proposals of M. Vakoolofsky in reference to an international congress, daily scientific paper, &c. A committee, consisting of representatives of all sections, appointed to discuss the subject of a French-German periodical, warmly advocated the proposal, and the meeting coming finally to the conclusion that pecuniary help from the Government would be desirable, intrusted the societies of the St. Petersburg's University (Naturalist, Physical, and Chemical), to draw out rules for the conduct of the periodical. Discussions on subjects relative to the teaching of natural sciences in Governmental schools being totally prohibited in the meetings (in order to avoid opposition to the anti-Natural Science tendencies of the ministry), a pedagogical committee, appointed to discuss the proposals of Prof. Halubinsky, decided that permission should be requested from the ministry to allow the meetings a pedagogical section to discuss at least some of the more special questions relative to the subject. The conclusions of the committee were accepted, as well as those of the Zoological Section, to request from the Naval Department the use of ships for scientific explorations in Russian seas. Finally, the small sum produced by the members' fees at the meeting (993 roubles from 331 members) was allowed for the publication of memoirs. The discussion of these various subjects having taken up much time, the members dispersed, and very few attended the lecture of M. Kostareff "On the Inductive and Deductive Methods of Reasoning and of Inquiry." The meeting was closed by a short address by the president, Prof. Brodŏfsky.

A. L.

PRINCIPLES OF TIME-MEASURING APPARATUS[1]

II.

The Pendulum.

IN that early apparatus I recently described, you will remember that the balance, after being set swinging in one direction, had its motion completely destroyed, and was then set swinging in the other, all by the direct agency of the clock-train. If it had possessed no other property than that merely of vibrating against the earth's attraction, the pendulum would have been an immense improvement upon this state of things, because every impulse delivered to it is, so to speak, stored up there, and is gradually expended therefrom as occasion requires in overcoming the friction due to its connections and the resistance of the atmosphere.

The discovery of the pendulum is generally attributed to Galileo, whose attention was attracted to the subject by watching the oscillations of a chandelier suspended by a very long line at a church in Pisa. The story is very likely to be a true one; anybody observing the shorter oscillations of a very long pendulum (fifty or sixty feet in length say) could scarcely fail to be impressed by them.

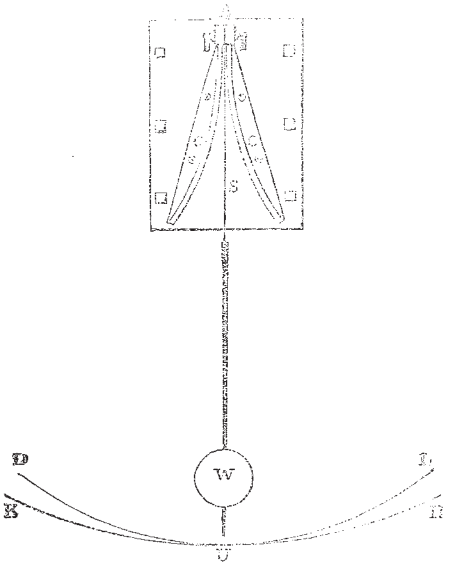

FIG. 9.

The celebrated Dutch philosopher, Huygens, first worked out its theory. He discovered that if a pendulum, instead of swinging in a circular arc (which it obviously does) could be made to move in a cycloidal, it would perform all its oscillations, whether large or small, in precisely equal times.

He succeeded in obtaining this motion for his pendulums by the following contrivance (see Fig. 9):—Two curves or cheeks, C C, starting from the axis of motion are placed one upon each side of the pendulum, which is suspended by a flexible line or spring S. As the pendulum swings, this line wraps around either curve and deflects the pendulum from its circular path, K U R, into the cycloidal, D U L. As you could almost infer from inspection the time of a pendulum swinging a cycloidal, is rather faster than when it swings a circular arc, the cycloidal being the more rapid curve. Also the time of the swing of a pendulum in a circular arc gets longer as the swing increases, that is to say, as it travels further up the curve; for instance, if the arc of a pendulum which was swinging 2° was increased to $2\frac{1}{2}$°, the loss of time due to the increased length of its swing would be four seconds a day.

The invention of these cycloidal cheeks or curves must have been looked upon as the *ne plus ultra* of perfection at the time; but in the first place they did not deflect the pendulum without a good deal of friction; and in the second it is rather advantageous than otherwise that a pendulum should gain in its shorter vibrations, because it never gets into them without retardation (which implies loss of time), and one error tends to correct the other.

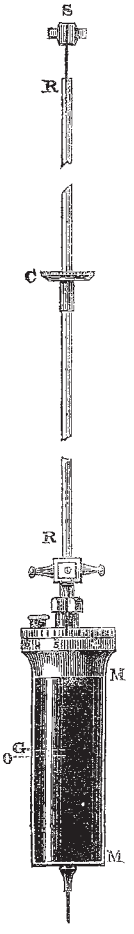

FIG. 10.

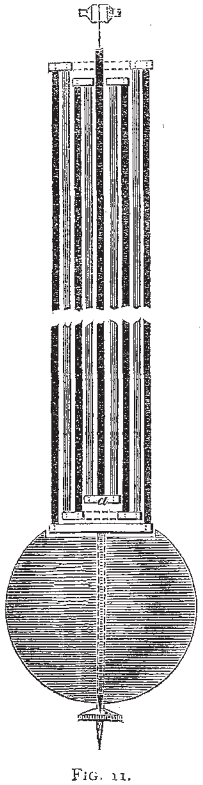

FIG. 11.

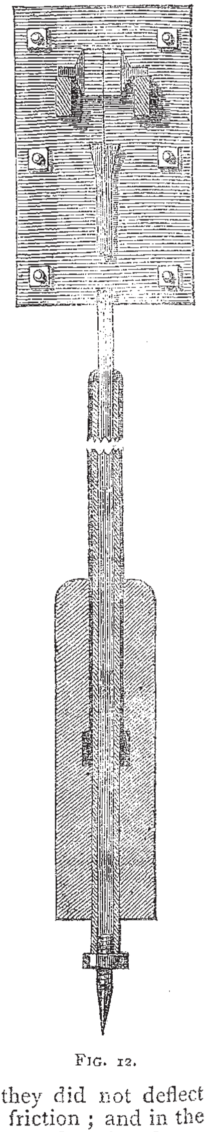

FIG. 12.

Huygens also discovered that the time of one swing of a pendulum varies as the square root of its length. The length of a pendulum swinging in one second is nearly 39·2 inches, and if you wish to find the time in which a pendulum of any other length will perform one swing, you divide the square root of that length by the

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[1] Lectures by Mr. H. Dent Gardner, at the Loan Collection, South Kensington. Continued from p. 531.